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TRANSITIONAL EFFECTS OF A PENSION SYSTEM CHANGE IN SPAIN [*]

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ABSTRACT

This paper studies the output effects, transition costs and the change in pension benefits derived from the substitution of the current unfunded pension system by a fully funded pension system financed through mandatory savings. These effects are estimated by using reduced versions of the neoclassical and endogenous growth frameworks. Because of the greater capital accumulation during the transition phase, final output increases by 23,6% (neoclassical framework); and a 24,5-31,5% (endogenous growth framework). The initial revenue loss for the government would represent a 4,8% of the GDP, raising very slowly during the transition period. Given the new growth rates, rates of return of physical capital, and financial intermediation costs, we have that the capitalization pension benefits obtained by all 30-contribution-year worker would be more than twice than those that guarantee the financial sustainability of the public pension system.

RESUMEN

Este artículo estudia los efectos sobre la producción, los costes de la transición y el cambio en las pensiones que se derivan de una substitución del actual sistema público de pensiones por otro alternativo de capitalización, financiado mediante ahorro obligatorio. Estos efectos se estiman utilizando versiones reducidas de los modelos de crecimiento neoclásico y endógeno. Debido a la mayor acumulación de capital durante la fase de transición, la producción final crece un 23,6% (modelo neoclásico); y entre un 24,5-31,5% (modelo de crecimiento endógeno). La pérdida de ingresos para el estado en el primer año equivaldría a un 4,8% del PIB, creciendo muy lentamente durante el período de transición. Dadas las nuevas tasas de crecimiento económico, las tasas de rentabilidad del capital físico y los costes financieros de intermediación, se obtiene que las pensiones de capitalización que alcanzaría todo trabajador con 30 años de cotizaciones serían más del doble que las que se pagarían en el sistema público de pensiones una vez garantizado su viabilidad financiera.

Keywords: Capitalization pensions, capital and output effects, transition costs.
J.E.L. classification: H55, O47.

1. Introduction.

The reform of the Social Security system has become one of the main issues of the public debate in many countries. Under the current pay-as-you-go, unfunded system, old workers' pensions are financed through the contributions of active workers. Because of demographic tendencies, such as the continuous increase in life expectancy and the reduction in the birth rate, the financing of future pensions under the current system is not viable, except if a drastic reform consisting basically of a reduction of future pension benefits is not adopted soon (see World Bank (1994) for the OECD countries; and Barea et al. (1995), Herce and Pérez-Díaz (1995), Monasterio et al. (1996) and Piñera and Weinstein (1996) for Spain).

Recent studies (Arrau (1990); Arrau and Schmidt-Hebbel (1993); Feldstein (1995); Huang, Imrohoroglu and Sargent (1995), Kotlikoff (1995)) have shown the existence of very major welfare and output gains in the US economy derived from the transition to a fully funded pension system[1]. These gains are fundamentally derived from the difference between the real rate of return of capital assets and the implicit return of a mature unfunded pensions system, given the rate of growth of total wage income. Whereas the before-tax real rate of return of capital assets has been around 7 percent in the American economy in the last 60 years, the average rate of growth of real wages has been less than 3 percent in the same period. Moreover, the persistent change in demographic tendencies -increases in life expectancy, reduction in the birth rate- has lowered the real rate

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[1] For instance, Kotlikoff (1995) finds that a transition beetwen the two pension systems financed through different combinations of tax increases would rise the steady state U.S. output until a 17%.

of return of pension contribution to negative levels in the US in recent years (see Feldstein (1995)).

This paper studies the effects on the level of GDP of a progressive change in Spain from the current Social Security system to an alternative privatized, fully funded system financed through mandatory savings. In addition, we analyze the viability of the reform, that is, we compute the cost for the government of the transition between the two pension systems. Finally, we compute the pension benefits derived from the implementation of the fully funded system and we compare them with the benefits derived from the current unfunded system under several measures close to the *Pacto de Toledo* reforms, that guarantee the financial sustainability of the pension system.

Under the pension reform designed in this paper, all workers who initially are less than 40 years old would place the proportion of their contributions to the current Social Security system allocated to the payment of their pensions in privately managed pension schemes, whereas older workers would continue in the old unfunded public system. During the transition phase between the two pension systems, the reform generates a public Social Security system deficit because of the loss of the contributions of the young workers. After a 25-30 years period in which the new capitalized pension system progressively replaces the old pay-as-you-go system, all workers would be in the private pension system. As usual in this pension scheme, future workers' pensions are financed by the returns of cumulative savings.

Different versions of the capitalized pension system have been already implemented in several countries. On one hand, some twenty countries, mostly former British colonies in Africa, Asia and the Pacific islands have mandatory, publicly managed pension plans. These countries had no public pay-as-you-go pension system when they established their national funded plan. On the other hand, Chile, which is the only country whose capitalized pension system is privately and competitively managed (see World Bank [1994])[2]. A common characteristic of these countries is the high savings rate generated by the capitalization system, which has been a key factor in explaining their relatively very high growth rates. In Singapore, workers capitalize, since July 1994, a 40% percent of their wages (20% each by the employer and the employee) in the publicly managed Central Provident Fund, established in 1955[3]. Since then, the gross domestic savings rate has been increased from 10 percent in 1955 to 39 percent in 1993[4]. At the same time the growth rate, which oscillated around an average of 2 percent per year in the 50s, increased to an average of more than 8 percent in the last thirty years. This rate of growth means that the Singaporean GDP requires less than nine years to double.

Closer to the pension reform designed in this work is the Chilean reform[5]. In Chile, the new capitalization system was introduced in 1981. Under the Chilean system, all covered workers must place a 10 percent of their monthly earnings in privately managed savings accounts. The success of the Chilean reform is almost unanimously recognized: pension plans have yielded an average

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[2] Hong-Kong has adopted a privately managed, mandatory fully funded scheme in July 1995, and is in process of drafting the subsidiary legislations to be enacted in early 1997.

[3] Singapore has the highest contribution rates in the world because the Central Provident Fund system permits accumulated assets to be used for other purposes as housing (during the 1980s, 2/3 of fund withdrawals were used for housing purchases), education or health care (see, Asher (1996) for a description of the Singaporean Central Provident Fund).

[4] According to Asher (1996), high contribution rates and rising wages have meant that the Central Provident Fund system has been an important contributor to Singapore's high savings. In 1991 the contribution to saving ranged from 16,3% of Gross National Saving (7,8% of GDP) to 30,4% of GNS (14,6% of GDP). In 1991 GNS was equal to 47,9% of GDP.

[5] For a more detailed analysis of the Chilean experience, see Diamond (1993) and Diamond and Valdes-Prieto (1994).

real rate of return of 12% during the last 15 years (Piñera and Weinstein [1995]), which implied that a great volume of funds were invested in the Chilean economy[6].

Moreover, as in Singapore, the reform has substantially increased the savings rate from 14 percent of the GDP in 1981 to 27 percent in 1995. As a consequence, the Chilean economy, which grew at a lower rate than the average of the Latin American countries until 1980, grew at a substantially greater-than-average rate of 7% per year during the last decade, making Chile -after Argentina- the country with a greater per capita GDP (measured in purchasing power parity) of all Latin American countries. This level was in 1993 comparable with that of Greece (World Development Report, 1995)[7].

We design a change in the pension system which verifies three properties. First, no worker (retired or active) must suffer a pension benefit loss during the transition period or in the steady state of the new capitalization system. Second, workers' contribution costs must be the same under the two alternative systems. In fact, throughout our analysis we impose the condition that the wage percentage contribution to the fully funded system must equal the actual burden of the contributions to the pay-as-you-go system. Third, the transition costs generated by the financing of public pensions must be "bearable" for the government. This condition imposes a lower limit on the transition period between the two pension

[6] Other remarkable merits of the Chilean pension system is the development of capital markets and the insulation of pension benefits from political risk (Diamond (1993)). Holzman (1996) points out that capital funds through the devolopment of capital markets have contributed to the growth rate of the Chilean economy between 0,9 and 2,1 percentage points. However, a major problem are the high intermediation costs because of the existence of many individual retirement accounts.

[7] Argentina, Colombia, and Perú have very recently adopted private, mandatory savings pension plans, following the case of Chile. Some Eastern European countries are considering similar schemes.

systems, because a very short transition period raises the public pensions financing burden[8].

The success of the proposed pension system reform depends crucially on the way in which the public pensions deficit is financed during the transition between the two pension systems. If the government chooses to finance the pension system through a reduction in public consumption, we find that the net savings effect of the transition is maximized, and so capital accumulation and output growth. The faster economy's growth reduces the burden of public pensions in the long run and raises the overall benefits of the new pension system. However, if the government finances pensions through proportional public deficit increases, the output and physical capital gains are substantially smaller, but -even in this case- there exists the possibility of such gains under realistic assumptions (see Feldstein (1995)). These gains are derived from the fact that the rate of return of the current unfunded system -and thus the service of the debt to be paid by the government- is much smaller than the average rate of return of physical capital[9]. A third option is to finance public pensions through either tax increases or transfers reductions. In this case, the net effect of the pension system change depends on the effect of these measures on private, voluntary savings.

To compute the capital and output accumulation effects of the transition to a fully funded pension system, we use two alternative frameworks: neoclassical and endogenous growth models. This approach allows a greater consistency of our results, which are largely independent on the macroeconomic framework used. In the neoclassical framework (Solow (1956)), technical progress is neutral

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[8] For instance, the cost of immediately shifting all workers to the privatized system would represent a 9,3% of the GDP.

[9] For the U.S. economy, the historical long run real rate of return of public debt has been of 0,5%, whereas before-tax rate of return of capital has been around 7%.

and exogenously given, there is perfect competition and the output technology presents constant to scale returns. In the alternative endogenous growth model (Romer (1986)), technological change increases with physical capital investment, and the assumptions of perfect competition and constant to scale returns do not necessarily hold.

Our main results can be summarized as follows. If we consider that the economy follows closely the neoclassical growth framework, we have that the pension reform would raise GDP by 23,6% in 2025. Alternatively, if we consider the endogenous growth as a more accurate description of the reality, the GDP growth is 31,5% in the case in which there is no significant substitution between mandatory, pension funds savings and the rest of savings. If we assume partial substitution of 20% between the two kinds of savings, the GDP growth is 24,5%, and when it is assumed a high partial substitution of 60% between contributions to the fully funded pension system and other forms of saving, the GDP growth is reduced to 11%. To obtain these results, we compare the projected evolution of the Spanish economy -assuming that GDP will grow at an average rate of 3%- with that obtained with the higher savings rate generated by the transition between the two pension systems.

We also obtain that the initial transition costs for the government of the pension reform here proposed are equivalent to 4,8% of the GDP. This cost is high, and implies a strong fiscal adjustment. However, empirical evidence (see Alesina and Perotti (1995)) shows several recent similar fiscal adjustments in democratic Western countries. For instance, in Belgium public deficit fell by 4% of the GDP in only one year, 1987. In Ireland, a quantitatively similar adjustment based almost exclusively on reductions of public expenditures was carried out in 1987-1989. Very recently, the American Congress has approved spending cuts which are substantially stronger than those here proposed (but the cuts will be carried out over the next seven years).

Finally, from the income redistribution perspective, it is obtained that all groups belonging to the "Régimen General" category are substantially benefited by the new pension system. The gains are really huge (2,9-3,2 times the pay-as-you-go pension under a harder version of the Pacto de Toledo reform) if we assume that the economy follows the endogenous growth framework -with a 3% capitalization rate. But even in the case in which the economy behaves as in the neoclassical model, we have that the median 30-contribution-year worker would receive a pension which is more than 2,3 times the same obtained under the public pension system. Workers' gains are enhanced by the fact that a greater output growth increases workers' wages and thus the contributions to the fully funded pension system.

The remainder of this paper is organized as follows. Section II describes the historical evolution of the Spanish public pension system and its perspectives. Section III finds the physical capital and output effects of the reform under a neoclassical growth framework; whereas Section IV obtains these effects under a simplified version of an endogenous growth model. Section V studies the initial cost and the evolution of the public pension system deficit generated by the transition to a fully funded pension system. Section VI calculates the pension benefits obtained under the new private pension system by every group of workers, and compares them with the pension benefits derived from the proposed Pacto de Toledo reforms. The Conclusion resumes the main results and considers the possibility of extensions of our approach.

2. Social Security in Spain: Historical Overview, Perspectives and Projected Reforms of the Public Pension System.

As in other European countries, the first institutions of the Spanish social welfare system were established at the beginning of this century. Since then, we can distinguish two clearly differentiated phases. During the first one (which finishes in 1963), the government creates several social security institutions which act separately. The most important of these institutions is the SOVI (Seguro Obligatorio de Vejez e Invalidez), which was a sort of an embryonic pay-as-you-go pension system.

The second stage starts in 1963 with the *Ley de Bases*. This law unified the different social protection institutions into a single pay-as-you-go Social Security system. Since the implementation of the new system, "contributive" pension expenditures have grown at an astonishing average real rate of 10% per year, and its weight has changed from 0,92% of the GDP in 1963 to 9,46% in 1996. In the same period the contribution resources obtained by the Social Security have grown at a much lower average real rate of 6%, increasing its GDP weight from 4,57% in 1963 to 10% in 1996. As a consequence of the greater expenditures' growth, the State transfer to the Social Security system has grown from nearly zero to a level of 4,9% of the GDP in 1996. State resources have been basically oriented to the financing of the Social Security health system.

The outstanding growth of public pensions expenditures has induced the government to adopt some measures oriented to the deceleration of pension expenditures. The most important of them is the *Ley de Medidas Urgentes para la Racionalización de la Estructura y de la Acción Protectora de la Seguridad Social*, promulgated in 1985. This law has raised the minimum contribution period required to receive a contributive pension from 10 to 15 years, from which two of them must be (at least) in the eight year period before the beginning of the pension payment. Other measures intended to curb the increase in pension expenditures -such as the rise of the minimum contribution period used to calculate the pension perceived- has been also implemented.

The 1985 law main achievement was a transitory, four year reduction of the percentage of public expenditure devoted to pension payments. After this period, the underlying negative demographic forces lead to a new increase in public pension expenditures. This increase has motivated a recent agreement between the government, political parties and social groups (*Pacto de Toledo* reform, October 1996) oriented to guarantee the viability of the public pension system. Since the burden of Social security contributions in Spain is already very high -around 25% of total labor costs-, the adoption of measures is basically intended to curb future pension expenditures increases.

However, to achieve this objective, the government must consider that, because of the projected rise in the number of pensioners, over 50% in the next 30 years (Herce and Pérez-Díaz (1995), Piñera and Weinstein (1996)), and the much slower growth of the occupied workers, between 0,5% and 0,7% per year (Carpio and Domingo (1996), Piñera and Weinstein (1996), the financial equilibrium between contributions and pension expenditures would be only achieved through a 30-40% reduction in real future pensions. In the long run, this reduction *does not depend* on the rate of growth of the productivity of workers. Effectively, a higher productivity growth implies greater Social Security revenues, but also higher pensions because pension benefits are calculated as an average of the wages perceived in the last period of the working life.

In a previous work, Gil (1997), was pointed out that the Pacto de Toledo reform, such as it was designed in October 1996, would be inadequate to accomplish the future financial liabilities of the Spanish Social Security system. Therefore, as long as we want to compare private pensions versus public pensions, we need to take into account other types of measures oriented to reform the public pension system in a more deep way. In particular, the main proposals analyzed in this work can be resumed as:

a) A gradual enlargement of the contribution period considered for the calculation of new pensions, from the average real wage of the last 8 years to the average real wage entire contribution period. This means an important reduction in the pension received by future retired workers, because real wages of very past periods (which are, on average, much lower than present wages) will weight the same as recent wages.
b) A progressive reduction in the percentage of discounted wages received as a pension by retired workers. Currently, a 15-year-contribution worker receives 60% of the average real wage corresponding to her last eight contribution years. Under this proposal, the percentage received is $CY_i/35$, where CY_i are the contribution years of the worker *i*. This means that (for instance) a 15-year-contribution worker will receive only 15/35 = 42,8% of the calculated base, which is given by the average real wage of the last 15 years (which is lower than the average wage of the last 8 years). A limit on the effectiveness of this measure to curb pension spending is that, actually, in the Régimen General, 75% of workers contribute more than 35 years.
c) A gradual increase in the retirement age to 68 or 70 years. This measure is intended to raise the effective contribution period and to reduce the pension benefit period.

The overall effect of the these proposed reforms is a substantial reduction in pension benefits. Gil (1997) shows that pension cuts -which oscillate between 22% and 44%- are general and significant, and they would be able to guarantee the financial equilibrium of the public pension system in the long run.

Next Section starts the study of an alternative reform aimed to guarantee the future payment of reasonable pension benefits: the change to a fully funded pension system.

3. Output Effects of the Privatization of Pensions: the Neoclassical Framework.

3.1 The Theoretical Framework.

This Section estimates the physical capital and output effects of the pension system transition by using a modified version of the Solow's model, Solow (1956), in which we include labor measured in efficiency terms. This approach is similar to that used by Mankiw, Romer, and Weil (1992).

We depart from a closed economy in which markets are perfectly competitive and firms maximize profits. The assumption of closed economy means that the interest rate of capital is not fixed and varies with the output-capital ratio[10]. The perfect competition assumption (in a Cobb-Douglas production function framework) implies the equality between the technical coefficients of the output production function and the income participation of different productive factors. Technological progress is assumed to be neutral and exogenously given. As usual, technological progress will be proxied by Total

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[10] Certainly, the hyphotesis of a closed economy is quite restrictive. But, for instance, is also used by Auerbach et al. (1989) when they study the interactions between demographic tendencies and social security policies for a set of developed countries. On the other hand, we have extensive evidence on international capital inmobility, including the lack of international. portfolio diversification, real interest differentials across countries or the high correlation between domestic savings and investment; again suggesting important barriers to capital mobility. In particluar, Argimón and Roldán (1994) finds emprical support for a low international capital mobility during the period 1960-1988 in Spain, because of effective capital controls.

Factor Productivity (TFP), which measures the growth of output unexplained by capital or labor increases.

Even if the ideal theoretical framework to study Social Security issues is an overlapping generations model (as in Arrau (1990), Arrau and Schmidt-Hebbel (1993), Feldstein (1995), Huang et al. (1995) and Kotlikoff (1995)), under which savings is endogenously determined, there exists empirical evidence (see, for instance, Hubbard (1984), Feenberg and Skinner (1989) and Venti and Wise (1990)) that shows that there is little or not substitution of savings derived from the introduction of pension plans. For this reason, we compute the model under this assumption, and we focus in the effects of the transition between the two pension systems under different technological assumptions.

3.1.1 Savings Behavior Under the Transition

The key variable in the model is the evolution of the *savings rate* during the transition phase to the new system. The economy's savings rate s_t is given by the sum of both private and public voluntary savings, s_v, and net mandatory savings, s_m. Net mandatory savings are given by the sum of the contributions to the capitalization system minus the capitalized pensions payments. But in the first stage of the transition between the two pension systems, nearly all contributions to the capitalized pension system (made by young workers) are net savings. This happens because there are almost no pension payments. Once the first cohort of young workers retire, the rate of net mandatory savings declines and, in the long run, eventually becomes zero. However, since mandatory savings are positive during the transition phase, capital and output (but not growth) will be greater in the long run under the fully funded system if the rate of total net savings - voluntary plus mandatory savings- effectively augments.

Voluntary savings can be affected by the capitalization of pensions through two ways. First, the private consumption-savings behavior of agents can be modified as a consequence of the introduction of the new pension system. Second, the way chosen by the government to finance the public pension deficit can modify the output effects of the pension system change because it can offset the positive savings effect of the transition between the two pension systems.

Since the decisions on the amount of individuals' resources allocated to pension plans are not taken by individuals but rather by the government, and since the reform proposed here assumes that the same fraction of wages is destined to the privatized system (as it is now), the only effect on individuals' savings decisions of the pension reform derives from the greater *expected* future pension under the fully funded system.

There are two effects of a greater expected pension. On one hand, the higher pension benefits has a negative income effect on voluntary savings[11]. On the other hand, since the risk inherent to a private pension system is higher than the risk associated to the alternative public system, if individuals are sufficiently risk-averse, they can decide to save more. The combined effect of an expected greater future pension and higher uncertainty can be either an increase or decrease in the rate of voluntary savings. Moreover, even in the case in which the total voluntary savings effect of the transition to a new pension system is negative, the existence of liquidity constraints in real economies that limit individuals' capacity to get indebted reduces the negative impact of the new pension system.

However, despite these theoretical arguments, we firstly start our analysis by assuming that the total individuals' voluntary savings rate effect of the implementation of a mandatory, fully funded pension system is zero. Secondly, next Section 4 -which considers a perhaps more sophisticated and realistic model- introduces the alternative assumption of a negative effect of mandatory savings on voluntary savings, and evaluates capital and output dynamics under this assumption.

On one hand, according to, for instance, Hubbard (1984), Feenberg and Skinner (1989) and Venti and Wise (1990), in which contributions to retirement accounts -such as IRAs, Keoghs and 401Ks- represent substantial net saving

[11] It is important to remark that we are refering to a mandatory pension scheme, so tax aspects of the program are leaved apart. When private pensions are tax favoured, there appears to be in optional savings plans the traditional ambiguity -for the marginal saver- between a substitution effect, which means less current consumption (because of the defered tax payments); and an income effect, which leads to a higher current and future consumption. For the intramarginal saver (whose savings is above the deductible limit) the favourable tax treatment on savings only causes an income effect.

increases[12], we will assume a little effect of 20% substitution of voluntary savings by mandatory savings. On the other hand, following other papers, for instance, Pesando (1991), Munnell and Yohn (1992) and Gale and Scholz (1994), in which contributions to private pension schemes have only a modest positive impact on total individual net saving, we will suppose that the crowd-out effect is as high as 60%.

There is a second way in which the rate of savings can be affected during the transition, which is the way chosen by the government to finance the public pensions deficit generated by the change between the two pension systems. The government can finance this deficit through three kinds of measures, or a combination of them: a reduction of public consumption, an increase in taxes or a reduction in transfers, and an increase in public deficit or a reduction of public investment. If the government chooses to finance the public pensions deficit through a proportional reduction in public consumption, there is no negative effect on aggregate savings. In this case, the capital accumulation and output growth effects of the transition are maximized. If the government raises taxes or reduces transfers, in general there is a negative effect on voluntary savings which depends on which tax or which type of transfer is chosen by the government. Finally, if the government runs an additional national debt of equal value to the public pension deficit, the increase in saving and output growth is reduced due to the payment of the debt service, and the transition costs will be substantially greater in the long run.

For our estimation purposes, we consider the case in which the government adopts the behavior which maximizes the capital and output effects, and finances

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[12] Lopéz García (1996), through a general equilibrium analysis framework, also shows that the tax favoured private pension plans are susceptible to cause higher levels of savings and capital accumulation.

the transition's pension deficit through a proportional reduction in public consumption expenditures. It is possible, of course, to assume that the pension system deficit is financed through other measures, such as a tax increase, but the computation of the economy's dynamics becomes more troublesome because we need to compute the negative induced savings effects of the tax increase. We thus estimate the capital and output effects of the pension system change in the neoclassical economy under the assumption that the savings rate is given by $s_t = s_v + s_m$.

It is important to remark that the economy's savings rate is only increased during the transition between the two systems (which lasts between 30 and 50 years, approximately). Thus, output only grows at a higher rate during the transition period, in which capital accumulation is faster because of the greater savings rate. The steady-state ratio between physical capital and output, equal to $K/Y = s/(d + g)$, does not change[13], because this ratio is only affected by the long run rate of savings, s, (which we assume that is the same under the two pension systems) as well as by the exogenous rate of depreciation of physical capital, d, and the exogenously given rate of technological change, g.

[13] This does not mean that the *levels* of both physical capital and output are also the same, because the transition raises the level of these two variables.

3.1.2 The Dynamics

The dynamics of the physical capital stock is given by the equation

$$K_t = (1-\delta)K_{t-1} + s_t Y_t \tag{1}$$

where δ is the physical capital depreciation rate, s_t is the savings rate and Y_t represents final output. Output is produced according to the constant-to-scale returns production function

$$Y_t = A_t K_{t-1}^{\alpha} H_t^{1-\alpha} \tag{2}$$

where H_t is a measure of human capital. Using the perfect competition assumption, α equals the participation of physical capital income with respect to total income. The Spanish national accounting suggests α = 0,5, and this value is used by some economists in their estimations. However, many other economists consider this value to high, because the accounting of capital income includes a part of autonomous workers' labor income. They take α = 0,4. We will take the most conservative approach in our estimation, that is, α = 0,4 (and hence 1- α = 0,6).

On the other hand, technical progress A_t evolves over time following the dynamic equation

$$A_t = A_{t-1}(1+g_A) \tag{3}$$

where g_A is the exogenously given rate of growth of technological progress.

3.2 Estimation Results.

In order to analyze the introduction of a fully funded pension system, we simulate the economy, by using the dynamic equations (1)-(3), under two different scenarios: first, a benchmark economy without any change in the Social Security system and second, an economy with a capitalized pension system, as it was designed above.

We depart from the benchmark economy in which output and physical capital grows at the same constant rate, 3% per year. This means that the capital-output ratio remains constant over time in the benchmark economy, and so the interest rate. The savings rate compatible with the capital and output growth, and the depreciation rate, is equal to 21%.

The MOISEES database provides historical data about real GDP Y_t, the capital stock K_t, the number of occupied workers L_t, and the depreciation rate of the capital stock, d[14]. We consider the depreciation rate $d = 0,062$ as a central value derived from the MOISEES database. We compute the amount of labor in efficiency units, H_t, the growth rate of technical progress g_A, and the net mandatory savings rate generated in the transition between the two pension systems.

To estimate human capital -or labor in efficiency units- we consider that the relative efficiency of different types of labor is measured by the difference in relative wages. For instance, if a worker with only primary education earns a gross wage of 2 million ptas. per year, and a worker with higher education earns 5 million ptas., this means that the higher education worker is 2,5 more productive than the primary education worker. Using this formalization and the data provided by the *Active Population Survey* and the *Wage Survey* (Instituto Nacional de Estadística), we to obtain the evolution of the structure of the working population measured by their educational achievement and the relative wages. Table I shows the data.

[14] See, *Series Macoeconómicas Asociadas al MOISEES*, Banco de España y Secretaría de Estado de Hacienda.

We obtain that, in the period 1963-1984, human capital grew at an average rate of 1,1 percent per year. In the period 1985-1994, the growth rate was 2,3 percent per year. This faster growth reflects the outstanding increase in higher education enrollment rates since the recession years. We take an intermediate value, 1,86 percent, as the projected average growth rate for human capital between 1996 and 2025.

The growth rate of technological progress, g_A, is immediately derived from our assumptions about the evolution of output, physical and human capital. Effectively, given the technology represented by equation (2) and a = 0,4; the rate of growth of TFP is $g_A = g_Y - 0,4\ g_K - 0,6\ g_H$. Using our projections, we obtain $g_A \cong 0,7\%$.

To estimate the alternative evolution of the economy under the transition between the two pension systems, we depart from the same initial values for physical capital K_t, GDP (Y_t), and technical progress, (A_t). The new savings rate is given by $0,21 + s_m$, where s_m is the mandatory savings rate generated by the pension reform. Using the previous values for all parameters, we have that the dynamics of the economy is given by the equations

$$K_t = (1 - 0,062)K_{t-1} + (0,21 + s_m)A_t K_{t_0}^{0,4}\left[H_0(1,0186)^t\right]^{0,6} \quad (4)$$

and

$$A_t = A_{t-1}(1 + 0,007) \quad (5)$$

Table II and III shows the results. Table II shows the actual evolution of savings, physical capital and output; assuming a GDP growth of 3%, whereas Table III shows the alternative evolution under the transition to a privatized pension system.

We can appreciate that, as a consequence of the greater savings rate generated during the transition between the two pension systems, physical capital increases a 68,7%, and output rises a 23,6% with respect to the actual evolution under the current public pension system. These figures imply that the average growth rate of physical capital changes from 3% (in the benchmark economy) to 4,7%, and that the average growth rate of the GDP rises from 3% to 3,7% in the period 1996-2025.

4. Output Effects of the Privatization of Pensions: the Endogenous Growth Framework.

The framework used in the previous Section has been widely criticized because of the lack of realism of their assumptions. Moreover, some empirical work, Boskin and Lau (1992), has rejected all the main hypothesis underlying the neoclassical framework: exogenous technological change, perfect competition, and constant to scale returns production function.

For this reason, with the objective of increasing the realism of our results, we alternatively estimate the effect of the privatization of pensions on aggregate savings, capital accumulation and output growth, by using a simplified version of the Romer's model (Romer (1986)). In this model, physical capital investment generates a public capital good which increases the productivity of the economy. However, in a similar way than under the neoclassical framework, in his paper Romer maintained the assumptions of perfect competition and constant to scale returns in privately appropriable inputs which, according to Boskin and Lau (1992), have been rejected by the empirical evidence. We relax these assumptions and, in addition, we introduce the different performance for investment and final output goods prices that has been observed in almost every economy[15], so we are implicitly considering a two-sector model in which capital and final goods are produced through different technologies.

We depart from the national accounting identity between gross investment and savings

$$\frac{P_{K_t}\left[K_t - (1-\delta)K_{t-1}\right]}{P_{Y_t} Y_t} = s_t \tag{6}$$

where K_t, K_{t-1} are the stocks of physical capital at *t* and *t-1* respectively, d is the depreciation rate of physical capital, Y_t is the gross domestic product, P_{Kt} and P_{Yt} are the physical capital investment and GDP deflactors respectively, and s_t is the economy's savings rate.

We consider different prices for capital goods and final output because the Spanish data for the period 1963-1995 show a different behavior for the two prices. In particular, the GDP deflactor grew by 0,8 percent per year more than the investment one. The implication of this empirical result is that cost reduction (and thus technological progress) is faster in the sector which produces capital goods than in the final output sector.

[15] Gordon (1990) shows that, on average, the relative price of equipement has fallen at a rate of more than 3% per year in the U.S.

4.1 The Production Function

We assume that output Y_t is generated through an aggregate production function that can be written in the form

$$Y_t = F(A_t K_{t-1}, H_t) \tag{7}$$

where A_t is technical progress and H_t is human capital, or labor measured in efficiency terms.

The above specification of the production function means the existence of capital-augmenting technical progress. This is consistent with empirical evidence from a sample of OECD countries, as Boskin and Lau (1992) show. These authors estimate an aggregate meta-production function without the conventional and restrictive assumptions of neutrality of technical progress, constant-to-scale returns, and profit maximization with competitive output and factors markets, implicit in the standard neoclassical Cobb-Douglas production function ($Y_t = A_t F[K_{t-1}, H_t] = A_t K_{t-1}^{\alpha} H_t^{1-\alpha}$). They obtain that technical progress is strongly complementary of capital formation, that technological progress can be represented by a single set of augmentation rates for capital, and that the elasticities of output with respect to physical capital and labor are $\alpha \in [0{,}21; 0{,}29]$ and $\beta \in [0{,}5; 0{,}55]$ respectively. Following their empirical findings, we assume that the aggregate production function (7) takes the form

$$Y_t = (A_t K_{t-1})^{\alpha} H_t^{\beta} \tag{8}$$

with $\alpha = 0{,}25$ and $\beta = 0{,}5$.

4.2 The Dynamics.

According to the empirical findings of Boskin and Lau (1992), we consider that technical progress evolves over time following the linear equation

$$\frac{A_t - A_{t-1}}{A_{t-1}} = \gamma g_{K_t} \tag{9}$$

where γ is a parameter that measures the influence of the growth rate of the physical capital stock, g_{Kt}, on technological innovation. The value of γ will be estimated through ordinary least squares.

Using the production function (8) and the equality between investment and savings given by (6), we have that the stock of physical capital follows the dynamic equation

$$K_t = (1-\delta)K_{t-1} + \frac{s_t}{P_t^*}(A_t K_{t-1})^{\alpha} H_t^{\beta} \tag{10}$$

where $P_t^* = P_{Kt} / P_{Yt}$ is the ratio between the prices of capital goods and final output. The economy's dynamics is given by equations (9)-(10).

The dynamics generated by the two dynamic equations (9) and (10) is studied in Appendix I. This Appendix shows that the model presented here converges to a balanced growth path in which P_{Kt} $(K_t$ - $(1\text{-}d)K_{t-1})$ / P_{Yt} Y_t is constant over time. The ratio K_t / H_t does not remain constant in the balanced growth path however, but this does not represent any problem for the model dynamics because human capital is labor measured in efficiency units in this model. In particular, given the parameter values here considered, it is obtained that physical capital grows at a higher rate than labor in efficiency units in the balanced growth path. This result is consistent with empirical evidence.

4.3 Estimation Results: No Substitution between Voluntary and Mandatory Savings.

As it was explained above, we take the empirically verified values of α = 0,25 and β =0,5. As in the Section 3, we consider the depreciation rate δ = 0,062 as a central value derived from the MOISEES database, and g_H = 1,86% per year as the estimated growth rate of human capital. The MOISEES database shows that the relative capital-output prices P_{Kt} / P_{Yt} decreased, on average, by 0,8% per year during the period 1963-1995. It is assumed that the decrease will be the same in the period 1996-2025 as it was during the period 1963-1995.

Equation (9): $g_A = \eta + \gamma\, g_K + \varepsilon$, where ,$\varepsilon \cong$ i.i.d $(0, \sigma^2)$ is estimated by the OLS estimation method. To do this, we differentiate logarithmically in the production function (8) and we substitute the dynamic equation for technical progress (9). We obtain

$$g_Y - \beta g_H = a + \alpha\left[(1+\gamma)g_K\right] \equiv a + bg_K \qquad (11)$$

where b = α $(1+\gamma)$. Table IV shows the estimation results. We can appreciate in this Table that *a* is not significant, so we neglect this parameter for the rest of our estimations. From α $(1+\gamma)$ = 0,544, we obtain γ = 1,176.

The previous results (*a* no significant, γgreater than one) mean that, as in Boskin and Lau (1992), exogenous technical progress is almost irrelevant, and that an increase in the growth rate of physical capital raises the rate of technological progress more than proportionally. These results are consistent with a production function which exhibits increasing returns once we have considered the effect of capital increase on technological change (as in Romer (1986)).

As in the previous Section, the benchmark economy grows at a 3% per year. We consider that the benchmark economy is in a balanced growth path, that is, K_t / Y_t does not change in the period considered. The reader can easily check that both the savings rate s = 21% and the human capital growth rate g_H = 1,86% are consistent with the steady state of this model. Using the previous values for all parameters, we have that the dynamics of the economy follows the equations

$$K_t = (1-0{,}062)K_{t-1} + \frac{0{,}21+s_m}{P^*_{t_0}(0{,}992)^t}\left[A_t K_{t-1}\right]^{0{,}25}\left[H_{t_0}(1{,}0186)^t\right]^{0{,}5} \quad (12)$$

and

$$A_t = A_{t-1}(1+1{,}176 g_{K_t}) \quad (13)$$

Table II and V shows the results. Table II shows the actual evolution of savings, physical capital and output; assuming a GDP growth of 3%, whereas Table V shows the alternative evolution under the transition to a privatized pension system.

We can appreciate that, as a consequence of the greater savings rate generated during the transition between the two pension systems, physical capital increases a 61,6%, and output rises a 31,5% with respect to the actual evolution under the current public pension system. These figures imply that the average growth rate of physical capital changes from 3,8% (in the benchmark economy) to 5,6%, and that the average growth rate of the GDP rises from 3% to 3,9% in the period 1996-2025.

4.4 Estimation Results: Partial Substitution between Voluntary and Mandatory Savings.

We relax the assumption of non substitution between voluntary and mandatory savings to consider that the implementation of a private pension scheme has a final negative effect on voluntary savings. On one hand, since some empirical studies (see, again, Hubbard (1984), Feenberg and Skinner (1989) and Venti and Wise (1990)) show a negligible substitution effect of private pension plans, we compute the dynamics of the model under the assumption that one percent of pension plan savings substitute 0,2 percent of voluntary savings, that is, we estimate

$$K_t = (1-0{,}062)K_{t-1} + \frac{(0{,}21-0{,}2s_m)+s_m}{P^*_{t_0}(0{,}992)^t}\left[A_t K_{t-1}\right]^{0{,}25}\left[H_{t_0}(1{,}0186)^t\right]^{0{,}5} \quad (14)$$

jointly with the dynamic equation (13).

On the other hand, according to other papers (see, for instance, Pesando (1991), Munnell and Yohn (1992) and Gale and Scholz (1994)) that show a high substitution effect of private retirement plans, it is also computed the dynamics of the model assuming that one percent of pension plan contributions substitute 0,6 percent of voluntary savings, that is, we estimate

$$K_t = (1-0{,}062)K_{t-1} + \frac{(0{,}21-0{,}6s_m)+s_m}{P^*_{t_0}(0{,}992)^t}\left[A_t K_{t-1}\right]^{0{,}25}\left[H_{t_0}(1{,}0186)^t\right]^{0{,}5} \quad (15)$$

jointly with the dynamic equation (13).

Table VI shows the evolution of savings, physical capital and output under the transition to a fully funded pension system with savings substitution of 20%. Comparing with the predicted of these variables (see Table II) we have that, under a 20% substitution parameter of voluntary by mandatory savings, physical capital increases under the transition between the two systems by 46,3% with respect to the benchmark economy; whereas output grows by a 24,5%. While Table VII shows the evolution of savings, physical capital and output with savings substitution of 60%. Again comparing with the predicted of these variables (see Table II) we have that, under a 60% substitution parameter of voluntary by mandatory savings, physical capital increases under the transition between the two systems by 18,3% with respect to the benchmark economy; whereas output grows by a 11%.

5. Transition Costs.

Once the capital and output effects of the pension system change has been computed under alternative approaches, an interesting exercise is the study of the cost for the government of the transition designed. These costs are derived from the deficit in the public pension system imposed by the loss of the contributions of younger workers, and by the condition that no individual who receives (or will receive) a public pension must be harmed by the pension change.

The estimation of the government transition costs is thus done as follows. The total amount of pension expenditures represents a 9,3% of the GDP. Using the data about the age composition of Social Security affiliated workers[16] and workers' wages (Castillo and Toharia (1991)), we estimate that the proportion of Social Security contributions made by workers with less than 40 years old will be 52% of overall contributions in 1996. From these figures, we have that the initial revenues loss for the government is (0,52) (9,3%) = 4,8% of the GDP.

How do the GDP proportion of transition costs evolve over time?. In a theoretical framework, there are two opposite effects. On one hand, the proportion of workers in the fully funded system increases over time, as workers' generations with less than 40 years in 1996 get older and generations with more than this age become retired. Thus, the revenue loss for the government becomes greater, because less people contribute to the old public system. On the other hand, the faster economic growth implies that the fraction of the GDP which covers the cost of the already existing public system is lower. Under the reform designed in this paper, the overall effect of these two effects is negative, and the GDP proportion destined to the financing of public pension rises from 4,8% to 7,4% in 2025, in the endogenous growth model with partial savings substitution of 20%; to 8,4% of the GDP in the case of a partial savings substitution of 60%; to 7% of the GDP in the model without savings substitution; and to 7,5% in the neoclassical framework.

Hence, the further fiscal adjustment originated by the over time increase in transition costs (2,2%-3,6% percentage points in 30 years) is not relevant in comparison with the 4,8% of the GDP initial fiscal adjustment. Moreover, we do not introduce in our analysis other important side effects of the transition between the two systems for the public finances. For instance, the greater investment and GDP growth is able to create a number of 250.000 new jobs equipped with the same capital as old jobs. This means a long run reduction in unemployment to nearly zero, and hence a reduction in unemployment subsidies, which nowadays represent a 3,5% of the GDP. In addition, the larger amount of active workers raises the tax base and implies greater government revenues even if tax rates are not increased.

6. A Comparison Of Pension Benefits Under The Two Systems.

[16] *Anuario de Estadísticas Laborales*. Ministerio de Trabajo y Seguridad Social, 1995.

A decisive variable in the political decision on the implementation of the new fully funded system must be the pension benefits of workers under the new system. On the other hand, it is worth to note, as it is shown in Gil (1997), that the deep Social Security reform needed to guarantee the viability of the public pension system in the long run would imply an average reduction in pension benefits of around 30-40%. For this reason, we will compute the public pension benefits taking into account a harder version of the Pacto de Toledo reform.

To compare with these pensions, we estimate the capitalization pensions corresponding to the rate of returns and wage increases implicit in our analysis. For instance, Table VIII shows the average rate of return of physical capital and the rate of growth of real wages (which is computed through the difference between the GDP growth rate and the 1% working population growth rate) for the endogenous growth model with savings substitution of 20% and 60%. It is assumed that workers contribute during 30 years to the private pension plan, a 24.8% pay-roll tax rate, retirement at 70, life expectancy at 90, a 10% financial intermediation costs of the yearly contributions[17]. It is also considered both a 3 and 5% capitalization rate of total wealth in pension funds. Notwithstanding, the pay-as-you-go pensions are calculated under a harder version of the Pacto de Toledo reform (see Section 2) and assuming that workers retire at 70, a 2% real wage growth rate and the last 35 years wage earnings computed in real terms but the last two in nominal terms.

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[17] In Chile (see Diamnond [1993]) the intermediation costs represented about 30% of the 10% mandatory savings rate. We consider smaller intermediation costs for Spain because, first, the greater degree of development of the Spanish financial market and, second, because the regulation of the Chilean reform implied measures such as the prohibition of collective pension funds, avoiding the obtention of potencial economies of scale that arise when the amount of pension funds managed by the financial intermediaries is greater.

Tables IX-X show the corresponding pension benefits for several groups of workers in the year 2025. We can appreciate that pension benefits under the fully funded system, with a real rate of capitalization of 3%, are between 2,3 and 3,2 times the pension obtained under a harder version of the Pacto de Toledo reforms for all workers' groups, and between 2,7 and 3,8 with a 5% capitalization rate. Notice also (see Appendix II) that private pensions are calculated assuming that widows receive a 100% of their consorts' pensions (in contrast with the 45% received under the public system) and that the same percentage of incapacity pensions are paid under the new system (25%).

7. Conclusion.

The objective of this Chapter is to show the fallacy of the two main objections to the introduction of a new privatized pension system, which are: a) the transition costs between the two systems are so high that the implementation of the new system is impossible in practice, b) only the richer individuals would benefit from the fully funded pension system. In contrast, we obtain that the financing of transition costs requires a fiscal adjustment which is not substantially greater than other fiscal adjustments experienced by democratic OECD countries. Moreover, because the future average real rate of return of the current pay-as-you-go system is quite low (see Chapter I), we show that the returns implicit in the new private system imply greater pension benefits for all workers than the public pension system (see also Chapter III).

In addition, this work shows that, whatever the theoretical framework considered, there are important output gains of the transition between the two pension systems. This result is not surprising after the work of Huang et al. [1995] or Kotlikoff [1995], among others. Using an Auerbach-Kotlikoff dynamic life-cycle model, Kotlikoff [1995] shows that, depending on the fiscal instruments adopted by the government, physical capital would be 52% higher and output 17% higher in the US after the transition between the two pension systems. Furthermore, these authors measure the welfare gains of the pension system change and they obtain that this gains are important. They obtain that these welfare gains are important. In Spain, the welfare gains of our proposed pension change are thus susceptible to be very significant, and a first and most important extension of our approach will be the estimation of these gains by using a dynamic general equilibrium model.

Some important questions arise in the practical implementation of the pension change. The first question is when this change must start. If the government wants to maximize the likelihood of a successful reform, the answer is easy: as soon as possible. The Spanish economy has recently started an expansion period that is usually decisive for a successful financing of fiscal adjustments. As empirical evidence shows, successful fiscal adjustment (Belgium, 1987; Ireland, 1987-1989) are normally carried out in expansive periods. Moreover, the dynamics of pension costs becomes costlier a future reform of the pension system.

A last issue is a political one, and has to do with the political incentives to implement a pension reform such as the proposed here. If the median voter approach were empirically valid, the results of this paper show that a potential government would have a very strong incentive to start the transition as soon as possible. However, information is incomplete and costly, electoral periods only last four years, and whereas almost the entire transition costs are beared during the first transition years, the benefits spread over a longer period. A practical implementation of the pension reform here defended is thus only possible through a process of becoming aware most of the population about the real and substantial gains derived from the pension system change.

8. Appendix.

Appendix I: The Dynamics of the Endogenous Growth Model.

To simplify the study of the endogenous growth model's dynamics, we first write an analogous, continuous time version of equations (9)-(10):

$$\dot{K}(t) = \frac{s}{P^{*}(t)} [A(t)\, K(t)]^{\alpha}\, H(t)^{\beta} - \delta\, K(t)$$

$$\frac{\dot{A}(t)}{A(t)} = \gamma \frac{\dot{K}(t)}{K(t)}$$

The solution of the last equation is given by $A(t) = C\, K(t)^{\gamma}$ where $C \equiv [A(t_0) / K(t_0)]^{\gamma}$. Substituting this result into the first equation and dividing by K(t), we have

$$\frac{\dot{K}(t)}{K(t)} = \frac{s}{P^{*}(t)} B\, K(t)^{\alpha(1+\gamma)-1}\, H(t)^{\beta} - \delta$$

For $a\,(1+\gamma) < 1$ (our estimations imply $a\,(1+\gamma) = 0{,}544 < 1$), for any initial value $K(t_0)$, the capital-output ratio (weighted by the relative prices) converges to a value such that the growth rate reaches its steady state value $g_K = (\beta\, g_H + \pi) / (1-a\,(1+\gamma))$ (π is the (negative) growth rate of $P_{K(t)} / P_{Y(t)}$). This result is due to the concavity of the equation $(s / P^{*})\, B\, K(t)^{a(1+\gamma)-1}\, H(t)^{\beta} - d$ with respect to K(t). Moreover, it is easy to show that, in the balanced growth path (where the nominal utput and the nominal value stock of physical capital grows at a common rate, g); the value of the ratio $p_{K(t)}\, K(t) / p_{Y(t)} Y(t)$ is equal to $s / (g + d)$.

Appendix II: Estimation of Pension Benefits

A. Pacto de Toledo.

The pension obtained under the Pacto de Toledo reform corresponds to the average real wage of the last 35 years before the first pension payment starts. However, the last two years of these 35 years are computed in nominal terms. Assuming that the inflation rate is π = 3%, and that wages grow at a yearly rate of g = 2%, the Pacto de Toledo corresponding pension is:

$$P_{PactoToledo} = \frac{w(T) + w(T-1)/(1+\pi) + w(t_0)/(1+\pi)[\int_{t_0}^{T-3} \exp(g\,(t - t_0))\,dt]}{T} =$$

$$\frac{w(35) + w(34)/(1+0{,}03) + w(0)/(1+0{,}03)\left[\exp(0{,}02)(33) - 1\right]/(0{,}02)}{35}$$

Using the data about initial wages for different workers, we obtain the pension values that appear in Tables IX-X.

B. Capitalization of Pension Funds.

In this case, the evolution of total wealth in pension funds *W(t)* follows the differential equation

$$\dot{W}(t) = r(t)W(t) + \theta w(t)(1 - x)$$

where *r(t)* is the average rate of return implicit in our results of capital and output evolution, *2* is the wage fraction destined to pension funds (equal to 0,248 in this exercise), and

$$w(t) = w(t_0)\exp\left[\int_{t_0}^{t} g_{w(s)}\,ds\right]$$

is the wage at *t* ($g_{w(s)} = g_{Y(s)} - g_N$ is the rate of growth of real wages, equal to the rate of growth of output minus the rate of growth of working population), and *x* is the fraction of the yearly contribution destined both to cover intermediation costs and incapacity pensions. We consider x = 0,35.

Solving the previous differential equation, we have

$$W(T) = \exp(\int_{t_0}^{T} r(s)ds)(W(t_0) + (1-x)\theta w(t_0)(\int_{t_0}^{T} \exp(\int_{t_0}^{t} g_{w(s)} ds)$$
$$\exp(-\int_{t_0}^{t} r(s)ds)))$$

This equation gives total wealth in pension funds at the end of the contribution period. Assuming that pensions remain constant in real terms, the annuity corresponding to that wealth is

$$P_{Capital.} = \frac{W(T)}{\int_{T}^{T^*} \exp\left[-\int_{T}^{t} r(s)ds\right]dt}$$

where T^* = max (E (Life)^{contributor}, E (Life)^{consort}) is the maximum life expectancy of the contributor to the pension plan and his or her consort, that is, we include widow pensions in our calculations. Under the assumptions r(s) = r = 0,05 and T^* = 20, we obtain the pension benefits shown in Tables IX-X.

TABLE I

Human Capital Data

Professional Categories	Gross Wage Earnings 1995	Structure of Ocupied Workers in terms of Educational Achievement		
		1964	1984	1994
College Degree	5.260.000	1,4	4,5	7,4
High-Skill	4.000.000	1,5	5,0	7,14
Middle-Skill	2.900.000	2,95	24,2	44,7
Low-Skill	2.000.000	78,8	53,3	32,7
Unskilled	1.370.000	9,1	10,7	7,2

Source: Active Population Survey and Wage Survey (Instituto Nacional de Estadística). Own estimations.

TABLE II

Actual Evolution of Savings Rates, Physical Capital and Ouput: 1996-2025
(with an output and capital accumulation estimated growth rates of 3%, in real thousand milion ptas. 1995)

Years	Savings Rate	Capital	Output
1996	0,21	154.673.855	68.455.056
1997	0,21	159.314.070	70.508.708
1998	0,21	164.093.492	72.623.969
1999	0,21	169.016.297	74.802.688
2000	0,21	174.086.786	77.046.769
2001	0,21	179.309.390	79.358.172
2002	0,21	184.688.671	81.738.917
2003	0,21	190.229.331	84.191.085
2004	0,21	195.936.211	86.716.817
2005	0,21	201.814.298	89.318.322
2006	0,21	207.868.727	91.997.871
2007	0,21	214.104.789	94.757.807
2008	0,21	220.527.932	97.600.542
2009	0,21	227.143.770	100.528.558
2010	0,21	233.958.083	103.544.415
2011	0,21	240.976.826	106.650.747
2012	0,21	248.206.131	109.850.270
2013	0,21	255.652.315	113.145.778
2014	0,21	263.321.884	116.540.151
2015	0,21	271.221.541	120.036.356
2016	0,21	279.358.187	123.637.446
2017	0,21	287.738.932	127.346.570
2018	0,21	296.371.100	131.166.967
2019	0,21	305.262.233	135.101.976
2020	0,21	314.420.100	139.155.035
2021	0,21	323.852.703	143.329.686
2022	0,21	333.568.285	147.629.577
2023	0,21	343.575.333	152.058.464
2024	0,21	353.882.593	156.620.218
2025	0,21	364.499.071	161.318.825

TABLE III

<u>Evolution of Savings Rates, Physical Capital and Output in a Neoclassical Model under the Transition to a Fully Funded Pensions System: 1996-2025</u>

(in real thousand milion ptas. 1995)

Years	Savings Rate	Capital	Output
1996	0,2581	158.526.231	68.455.057
1997	0,2605	167.373.769	71.690.633
1998	0,2629	176.604.581	74.576.029
1999	0,2653	186.234.507	77.558.146
2000	0,2678	196.280.039	80.640.466
2001	0,2702	206.758.344	83.826.582
2002	0,2724	217.669.299	87.120.198
2003	0,2746	229.030.379	90.522.146
2004	0,2768	240.859.765	94.036.302
2005	0,2790	253.176.371	97.666.662
2006	0,2812	265.999.867	101.417.347
2007	0,2830	279.307.228	105.292.607
2008	0,2848	293.117.167	109.290.022
2009	0,2866	307.449.143	113.413.951
2010	0,2884	322.323.388	117.668.883
2011	0,2902	337.760.924	122.059.441
2012	0,2915	353.723.482	126.590.392
2013	0,2928	370.230.424	131.257.726
2014	0,2942	387.301.871	136.066.275
2015	0,2955	404.958.728	141.021.012
2016	0,2968	423.222.703	146.127.054
2017	0,2978	442.066.316	151.389.670
2018	0,2988	461.510.344	156.807.187
2019	0,2998	481.576.351	162.384.998
2020	0,3008	502.286.710	168.128.649
2021	0,3018	523.664.621	174.043.847
2022	0,3020	545.600.246	180.136.461
2023	0,3023	568.111.947	186.394.241
2024	0,3025	591.218.795	192.822.883
2025	0,3028	614.940.574	199.428.228

TABLE IV

<u>Ordinary Least Square Estimation of Equation 11</u>
(based on data for 1963-1995)

Variable	Beta	Standard Error	t - Statistic
g_k	0,544	0,07046	7,724
(Constant)	0,0066	0,45543	0,014

R Square	0,673
Adj. R Square	0,662
Standard Error	1,235
F - Statistic	59,7
Confidence Interval	(0,425 - 0,663)

Source: Own estimations.

TABLE V

Evolution of Savings Rates, Physical Capital and Output in a Endogenous Growth Model without Savings Substitution under the Transition to a Fully Funded Pensions System: 1996-2025

(in real thousand milion ptas. 1995)

Years	Savings Rate	Capital	Output
1996	0,2581	158.668.714	68.455.057
1997	0,2605	167.676.244	71.201.455
1998	0,2629	177.220.145	74.065.511
1999	0,2653	187.330.756	77.051.872
2000	0,2678	198.040.078	80.165.375
2001	0,2702	209.381.863	83.411.053
2002	0,2724	221.372.776	86.794.144
2003	0,2746	234.048.457	90.315.825
2004	0,2768	247.446.447	93.981.543
2005	0,2790	261.606.284	97.796.964
2006	0,2812	276.569.610	101.767.985
2007	0,2830	292.332.268	105.900.741
2008	0,2848	308.935.655	110.191.582
2009	0,2866	326.423.284	114.646.618
2010	0,2884	344.840.888	119.272.196
2011	0,2902	364.236.536	124.074.918
2012	0,2915	384.590.810	129.061.650
2013	0,2928	405.949.953	134.225.990
2014	0,2942	428.362.471	139.574.637
2015	0,2955	451.879.244	145.114.554
2016	0,2968	476.553.642	150.852.973
2017	0,2978	502.380.220	156.797.413
2018	0,2988	529.411.838	162.944.623
2019	0,2998	557.703.869	169.302.131
2020	0,3008	587.314.319	175.877.757
2021	0,3018	618.303.954	182.679.624
2022	0,3020	650.562.693	189.716.170
2023	0,3023	684.141.163	196.966.927
2024	0,3025	719.092.271	204.439.441
2025	0,3028	755.471.296	212.141.535

TABLE VI

Evolution of Savings Rates, Physical Capital and Output in a Endogenous Growth Model with Savings Substitution of 20% under the Transition to a Fully Funded Pensions System: 1996-2025

(in real thousand milion ptas. 1995)

Years	Savings Rate	Capital	Output
1996	0,2485	158.004.935	68.455.057
1997	0,2504	166.281.784	71.036.848
1998	0,2523	175.023.024	73.724.557
1999	0,2543	184.253.591	76.522.219
2000	0,2562	193.999.731	79.434.032
2001	0,2581	204.289.069	82.464.359
2002	0,2599	215.135.740	85.617.733
2003	0,2617	226.568.948	88.895.457
2004	0,2634	238.619.398	92.302.254
2005	0,2652	251.319.368	95.843.033
2006	0,2670	264.702.794	99.522.894
2007	0,2684	278.767.841	103.347.138
2008	0,2698	293.548.505	107.313.286
2009	0,2713	309.080.457	111.426.652
2010	0,2727	325.401.131	115.692.748
2011	0,2742	342.549.807	120.117.303
2012	0,2752	360.513.594	124.706.265
2013	0,2763	379.330.744	129.455.056
2014	0,2773	399.041.323	134.369.536
2015	0,2784	419.687.298	139.455.782
2016	0,2794	441.312.627	144.720.104
2017	0,2802	463.916.234	150.169.050
2018	0,2810	487.542.082	155.800.651
2019	0,2818	512.236.162	161.621.506
2020	0,2826	538.046.592	167.638.460
2021	0,2834	565.023.710	173.858.617
2022	0,2836	593.087.894	180.289.346
2023	0,2838	622.282.571	186.915.181
2024	0,2840	652.653.063	193.742.853
2025	0,2842	684.246.669	200.779.337

TABLE VII

Evolution of Savings Rates, Physical Capital and Output in a Endogenous Growth Model with Savings Substitution of 60% under the Transition to a Fully Funded Pensions System: 1996-2025

(in real thousand milion ptas. 1995)

Years	Savings Rate	Capital	Output
1996	0,2292	156.677.378	68.455.057
1997	0,2302	163.502.541	70.707.635
1998	0,2312	170.659.155	73.043.202
1999	0,2321	178.162.800	75.464.643
2000	0,2331	186.029.791	77.974.951
2001	0,2341	194.277.214	80.577.223
2002	0,2350	202.915.692	83.274.673
2003	0,2358	211.963.386	86.068.932
2004	0,2367	221.439.298	88.963.368
2005	0,2376	231.363.316	91.961.472
2006	0,2385	241.756.251	95.066.858
2007	0,2392	252.622.026	98.283.273
2008	0,2399	263.982.000	101.610.645
2009	0,2406	275.858.494	105.052.804
2010	0,2414	288.274.837	108.613.716
2011	0,2421	301.255.413	112.297.489
2012	0,2426	314.800.481	116.108.376
2013	0,2431	328.934.655	120.045.484
2014	0,2437	343.683.629	124.113.116
2015	0,2442	359.074.223	128.315.729
2016	0,2447	375.134.434	132.657.934
2017	0,2451	391.871.930	137.144.504
2018	0,2455	409.315.501	141.776.082
2019	0,2459	427.495.178	146.557.572
2020	0,2463	446.442.283	151.494.050
2021	0,2467	466.189.487	156.590.770
2022	0,2468	486.711.328	161.853.168
2023	0,2469	508.038.657	167.275.582
2024	0,2470	530.203.596	172.863.280
2025	0,2471	553.239.581	178.621.711

TABLE VIII

Average Rates of Return of Physical Capital and Wage Growth Rates in a Endogenous Growth Model with Savings Substitution of 20% and 60% under the Transition to a Fully Funded Pensions System: 1996-2025

	Substitution of 20%		Substitution of 60%	
Years	**r**	**g_w**	**r**	**g_w**
1996	0,1218	0,0200	0,1218	0,0200
1997	0,1207	0,0277	0,1214	0,0229
1998	0,1197	0,0278	0,1211	0,0230
1999	0,1186	0,0279	0,1207	0,0232
2000	0,1175	0,0281	0,1202	0,0233
2001	0,1164	0,0281	0,1198	0,0234
2002	0,1153	0,0282	0,1194	0,0235
2003	0,1143	0,0283	0,1189	0,0236
2004	0,1132	0,0283	0,1185	0,0236
2005	0,1121	0,0284	0,1180	0,0237
2006	0,1110	0,0284	0,1175	0,0238
2007	0,1100	0,0284	0,1171	0,0238
2008	0,1089	0,0284	0,1166	0,0239
2009	0,1079	0,0283	0,1161	0,0239
2010	0,1069	0,0283	0,1157	0,0239
2011	0,1059	0,0282	0,1152	0,0239
2012	0,1049	0,0282	0,1147	0,0239
2013	0,1040	0,0281	0,1143	0,0239
2014	0,1031	0,0280	0,1138	0,0239
2015	0,1022	0,0279	0,1134	0,0239
2016	0,1013	0,0277	0,1129	0,0238
2017	0,1004	0,0277	0,1125	0,0238
2018	0,0996	0,0275	0,1121	0,0238
2019	0,0988	0,0274	0,1117	0,0237
2020	0,0980	0,0272	0,1113	0,0237
2021	0,0973	0,0271	0,1109	0,0236
2022	0,0965	0,0270	0,1105	0,0236
2023	0,0959	0,0268	0,1101	0,0235
2024	0,0952	0,0265	0,1098	0,0234
2025	0,0946	0,0263	0,1095	0,0233

TABLE IX

Pay-As-You-Go Pension Benefits vs Fully Funded Pension Benefits computed under t
(with a capitalization rate of 3%)

Gross Wage Earnings	Pay-As-You-Go Pension Benefits	Capital.Annuity (Neoclassical Model)	Capital. Annuity (Endogenous Model without Substitution)	C (E
5.260.000	6.726.092	15.373.264	19.067.964	
4.000.000	5.114.899	11.690.695	14.500.353	
2.900.000	3.708.302	8.475.754	10.512.756	
2.000.000	2.557.450	5.845.347	7.250.176	
1.370.000	1.751.853	4.004.063	4.966.371	

Assumptions:
Fully Funded Pension: 30 contribution years, retirement at 70, life expectancy at 90, a 24.8% pay-roll tax ra
3% capitalization rate of total wealth in Pension Funds.

Pay-as-you-go Pension (Pacto de Toledo reform): retirement at 70, 2% real wage growth rate, the last 35 yea
but the last two in nominal terms.

TABLE X

Pay-As-You-Go Pension Benefits vs Fully Funded Pension Benefits computed under t
(with a capitalization rate of 5%)

Gross Wage Earnings	Pay-As-You-Go Pension Benefits	Capital. Annuity (Neoclassical Model)	Capital. Annuity (Endogenous Model without Substitution)	Ca (E
5.260.000	6.726.092	18.288.278	22.683.551	
4.000.000	5.114.899	13.907.435	17.249.849	
2.900.000	3.708.302	10.082.891	12.506.140	
2.000.000	2.557.450	6.953.718	8.624.924	
1.370.000	1.751.853	4.763.297	5.908.073	

Assumptions:
Fully Funded Pension: 30 contribution years, retirement at 70, life expectancy at 90, a 24.8% pay-roll tax ra
5% capitalization rate of total wealth in Pension Funds.

Pay-as-you-go Pension (Pacto de Toledo reform): retirement at 70, 2% real wage growth rate, the last 35 yea
but the last two in nominal terms.

References

Alesina, A., and R. Perotti (1995) «Fiscal adjustments», *Economic Policy*, no.21.

Argimón, I. and J.M. Roldán (1994) «Saving, investment and international capital mobility in EC countries», *European Economic Review*, no. 38, p.: 59-67.

Arrau, P. (1990) «*Social security reform: the capital accumulation and intergenerational distribution effect*», World Bank, Washington D.C.

Arrau, P., and K. Schmidt-Hebbel (1993) «*Macroeconomic and intergenerational welfare effects of a transition from pay-as-you-go to fully funded pensions*», World Bank, Washington D.C.

Asher, M.G. (1996) «*Financing old age in Singapore: are there any lessons for welfare states?*», presented for the Third International Research Seminar on Issues in Social Security, Foundation for International Studies in Social Security, May 11-14, Sigtuna, Sweden.

Auerbach, A., L.J. Kotlikoff, R.P. Hagemann and G. Nicoletti (1989) «The economic dynamics of an aging population: the case of four OECD countries», *OECD Economic Studies*, vol. 12.

Barea, J., E. Domingo, M. Carpio, D. Dizy, O. Ruiz, M. Fernández and D. Cano (1995) «*El sistema de pensiones en españa: análisis y propuestas para su viabilidad*», Círculo de Empresarios, Madrid, Monografía: enero 1995.

Boskin, M.J., and L.J. Lau (1992) «Capital, technology, and economic growth», in N. Rosenberg, R. Landau, y D.C. Mowery (eds.), "*Technology and the wealth of nations*", Stanford: Stanford University Press.

Carpio, M., and E. Domingo (1996) «*Presente y futuro de las pensiones en españa*», Ediciones Encuentro, Madrid.

Castillo, S., and L. Toharia (1991) «Las desigualdades en el trabajo», in "*Mercado de trabajo y desigualdad*", vol. 4. Fundación Argentaria.

Diamond, P.A. (1993) «Privatization of social security: lessons from Chile», *NBER Working Paper*, no. 4510, Cambridge, Massachusetts.

Diamond, P.A., and S. Valdes-Prieto (1994) «Social security reforms» in B. Bosworth (ed.), "*Chilean economy: policy lessons and challenges*", Washington: Brookings Institutions.

Feenberg, D., and J. Skinner (1989) «Sources of IRA saving», *NBER Working Paper*, no. 2845, Cambridge, Massachusetts.

Feldstein, M. (1995) «Would privatizing social security raise economic welfare?», *NBER Working Paper*, no. 5281, Cambridge, Massachusetts.

Gil, J. (1997) «*La seguridad social en España: aspectos redistributivos inter e intrageneracionales, y consideraciones para su reforma*», Phd Thesis, 1997 Universidad de Barcelona.

Gale, W.G. and J.K. Scholz (1994) «IRAs and household saving», *American Economic Review*, vol. 84, no. 5 (December), p.: 1233-1260.

Gordon, R. (1990) «The measurement of durable goods prices», *NBER Working Paper*, Cambridge, Massachusetts.

Herce, J.A., and V. Pérez-Díaz (directors), S. Castillo, R. Duce, J.F. Jimeno, O. Licandro, D. Rodriguez and S. Sosvilla-Rivero (1995) «*La reforma del sistema público de pensiones en España*», Colección de Estudios e Informes, no. 4, Caja de Ahorros y Pensiones de Barcelona, Barcelona.

Holzman, R. (1996) «Pension reform, financial market development, and economic growth: preliminary evidence from Chile», *IMF Working Paper* (August) 1996.

Huang, H., S. Imrohoroglu and T.J. Sargent (1995) «*Two computacionals experiments to fund social security*», mimeo, Department of Economics, University of Chicago.

Hubbard, R.G. (1984) «Do IRAs and KEOGHs increase saving?», *National Tax Journal*, no. 37, p.: 43-54.

Kotlikoff, L.J. (1995) «Privatization of social security: how it works and why it matters», *NBER Working Paper*, no. 5330, Cambridge, Massachusetts.

López-García, M.A. (1996) «¿Aumenta el ahorro el tratamiento fiscal favorables de las pensiones privadas?», *Papeles de Trabajo*, no. 23-96, Instituto de Estudios Fiscales.

Mankiw, G.N., D. Romer, and D.N. Weil (1992) «A contribution to the empirics of economic growth», *Quarterly Journal of Economics*, vol. 107, no. 2 (May), p.: 407-437.

Monasterio, C., I. Sánchez, and F. Blanco (1996) «*Equidad y estabilidad del sistema de pensiones español*», Fundación BBV, Bilbao.

Munnell, A. and F. Yohn (1992) «What is the impact of pensions on savings?», in Bodie, Z. and A. Munnell (eds.) ”*Pensions and the economy: sources, issues and limitations of data*“, Philadelphia: University of Pennsylvania Press, 1992.

O.E.C.D (1995) «*Effects of aging populations on government budgets*», Economic Outlook, no. 57 (June), p.: 33-42.

Pesando, J. (1991) «*The multiple roles of private pensions: effect on savings, capital markets, and labour market decisions*», presented at the OECD Conference on Private Pensions and Public Policy, Paris.

Piñera, J., and A.Weinstein (1996) «*Una propuesta de reforma del sistema de pensiones en España*», Círculo de Empresarios, Madrid.

Romer, P.M. (1986) «Increasing returns and long run growth», *Journal of Political Economy*, vol. 94, no. 5 (October), p.: 1002-1037.

Solow, R.M. (1956) «A contribution to the theory of economic growth», *Quarterly Journal of Economics*, no. 70, vol.1 (February), p.: 65-94.

Venti, S.F., and D.A. Wise (1990) «Have IRAS increased U.S. saving?: evidence from consumer expenditure surveys», *Quarterly Journal of Economics,* 105, no. 3 (August), p.: 661-698.

World Bank (1994) «*Averting the old age crisis: policies to protect the old and promote growth*», World Bank, Washington D.C.

World Bank (1995) «*World development report 1995*», World Bank, Washington D.C.